AN ACCOUNT OF SOME Experiments and Obſervations ON TAR-WATER:

Wherein is ſhown the QUANTITY of TAR that is therein.

AND ALSO

A METHOD propoſed, both to abate that QUANTITY conſiderably, and to aſcertain the STRENGTH of the TAR-WATER.

Which was read before the ROYAL SOCIETY.

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LONDON:
Printed for R. MANBY and H. S. Cox on *Ludgate-Hill.*
MDCCXLV.
(Price Six-pence.)

AN ACCOUNT

Experiments and Observations

TAR-WATER.

I.

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ACCOUNT

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Experiments and Obſervations

ON

TAR-WATER.

I.

1. AS the celebrated Tar-water, recommended by the worthy and learned Biſhop *Berkeley*, is ſaid to be taken with great Benefit by ſome, and Detriment by others; I thought it might probably be of uſe to inquire whether any, or what Quantity of Tar, there was in Tar-water, made with different kinds of Tar, different Degrees of ſtirring, and in dif-

ferent Ways of making it. A ſhort Account of which I ſhall give, without intereſting myſelf, either in Favour or Diſfavour of a Medicine that is under the Inſpection of the proper Judges, as well as of all the reſt of the World.

2. Upon Inquiry from knowing Perſons, I find that *Norway* or *Swediſh* Tar, which is dark, thick and clear, without obſcure Grains in it, is accounted the beſt, for the general Uſes of Tar: But that the Tar which is made of the Tops of Fir-Trees, which are become very hard, by having lain long dead on the Ground, after having either fallen of themſelves, or being killed by the draining off their Turpentine Sap, thro' Baſin-like Notches cut near their Bottoms: (Theſe Tops are commonly called Light-wood, the poorer People making uſe of them inſtead of Candles:) This Tar being burned in a very ſtrong Fire of ſuch

dry Wood, is of a very cauſtick, corroding Nature, ſo as to be hurtful to Ropes, &c. for which reaſon it is not uſed in the Royal Navy. But the *American* Tar, which is made of green Fir-Trees, with a leſs degree of Fire, is eſteemed good, and is called green Tar; for which reaſon a Bounty, double the Value of the other, is allowed by the Government here, on Importation.

3. HAVING procured ſome *Norway* or *Swediſh* Tar, which was thirty Years old, and very thick and ſtiff; I, according to the Biſhop's Preſcription, made Tar-water in the proportion of a Gallon of Water to a Quart of Tar, ſtirring it four Minutes: I then took a Pint of this Tar-water, and evaporated it away in a *Florence* Flask, cut to a wide Orifice, with a red-hot circular Iron, and weighed. Beſides what flew off in Evaporation, there remained at the Bottom of the Flask

forty-four Grains of thick, dark, reddiſh Tar, of a bitteriſh burnt Taſte. On evaporating a like quantity of Tar-water, made with common, coarſe, ſtiff *American* Tar, in the ſame manner, there remained twenty-eight Grains of a like ſyrupy Tar; and ſixty-one Grains in a Pint of Tar-water made with a ſtiff Tar, juſt brought from *Norway*. This Water was high coloured on ſtanding ſome days.

4. I evaporated away alſo a Pint of Tar-water, made with the old Tar, which had been ſtirred for half an Hour, in order to try how ſtrongly it might be impregnated with Tar. There remained ninety-three Grains, which Reſiduum was not all of it a ſyrupy Tar, as the former, but partly incruſted on the Sides of the Flask; which ſhews how much more of the groſſer Tar was incorporated in this Water than in the other. This was alſo evident by its greater and more

laſting

lasting Froth on shaking, and also by its deeper Colour, it becoming brown as Beer, on a few Days standing: And even the thinner kind of Tar, which was stirred for eight Minutes, had twenty-six Grains of Tar left, on Evaporation of a Pint of its Water. Hence we see the Effects of stirring Tar-water much.

II.

5. FINDING forty-four Grains in a Pint of the first Water, Section or Numb. 3. it occurred to me, that probably there might be less Tar in the Water, if it could be made without stirring it with a Stick, which stirring may impel some of the grosser Tar into the Water, whence its too heating Quality is with good reason thought to arise. I therefore put half a Pint of Tar into a Tin Pot, whose Bottom was punched full of Holes, one sixth of an Inch in Diameter, and half an

Inch

Inch diſtant from each other; which I found to be a proper Size for this very thick Tar; thro' which the Tar dropped gradually into a Quart of Water, when placed in hot Sunſhine; or elſe at ſuch a diſtance before a Fire, as would give a like Degree of Heat, ſufficient to make it drop. But finding, on evaporating off a Pint of this thus prepared Tar-water, with Warmth, thirty-two Grains of thick Tar; for it is well known, that Fluids in a warm State will imbibe a greater Quantity of Matter, than when cold: I made another Tar-ſtrainer, being a Box of Wood, which was ſquare, and two and an half Inches wide in the Clear within, and eight Inches deep, with a Pewter Bottom, which had twenty-five Holes in it, one eighth of an Inch in Diameter: There was alſo a wooden Plug or Rammer, whoſe bottom part was exactly fitted to it; by which Plug, the cold Tar was gradually forced, in ſlender Streams, like Rain, thro

the

the Bottom of the Strainer. There were fixed on each side of the Strainer Pieces of Wood two Feet long, like the Poles of Chairmens Chairs, on these the Strainer rested at a proper distance over the Pot of Water.

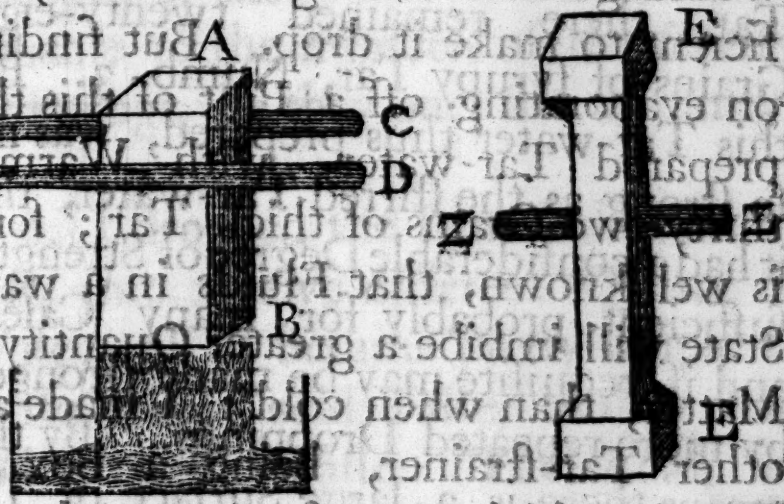

Fig. A B *the Strainer-box.* C C D D *the Arms or Poles two Feet long to rest it on.* E E *the Plug.* Z Z, *a wooden Pin, which hindered the Bottom of the Plug from pressing hard on the Bottom of the Strainer.*

I found but eighteen Grains of syrupy Tar, on evaporating a Pint of Tar-water thus prepared, by the same old Tar's

dropping

dropping five times on it: And but ſix Grains in a like Quantity of Tar-water, made by dropping coarſe *American* Tar five times on the ſame Water; whereas in a Pint of Tar-water made by ſtirring ſome of the ſame Tar, there remained twenty-eight Grains of ſyrupy Tar, Numb. 3. But this Tar-water thus prepared, was not ſo ſtrong as the ſtirred Tar-water, tho' it had a conſiderable Degree of Strength, ſufficient probably for many Caſes; and if requiſite may be made ſtronger, by more repeated Droppings. By this means there is a large Surface of Tar expoſed to the Water, to be thereby impregnated with the Virtue of the Tar, without forcing in the groſſer Parts, by ſtirring with a Stick: For it ſeems probable, that there is not ſo great a quantity of the Surface of the Tar expoſed to the immediate Contact of the Water in ſtirring ſo ſtiff a Maſs of Tar, as in the dropping way. This being ſomething like Nature's Method

of

of impregnating mineral Waters, with the Virtue of *Petroleum*, or Tar of the Earth, as they gently glide among it; By this means likewiſe, there will be a greater Certainty, in adjuſting the Strength of Tar-water; for the ſtrength of the Water will be proportionable to the numbers of the ſeveral Droppings, be they one, five or more.

6. I dropped the ſame half Pint of Tar, into twelve different Quarts of Water, till it became pretty inſipid as to the ſaline, acid Taſte, tho' it had ſtill a tarriſh Taſte. The Acid, in which the Virtue is thought principally to reſide, might be ſenſibly taſted in the fourth Quart, and farther; for the Drops of Tar are in every Operation formed, partly with a new Surface to expoſe to the Water. And it is obſerved in the Diſtillation of Turpentine, that ſome of this acid Spirit ariſes to the laſt, being ſtill intangled in the Turpentine.

7. When Tar-waters of different Degrees of Strength were put into *Florence* Flasks, with other inverted Flasks fixed on them, and all were placed in the ſame Veſſel of hot Water; on breaking the upper Flasks, the volatile acid Spirit could very ſenſibly be taſted, eſpecially that of the ſtronger Tar-water; which ſhows that theſe Waters are impregnated therewith: and which, when diſtilled from Turpentine, Dr. *Boerhaave* in his Chemiſtry ſays, is the beſt vegetable Acid that is known. This Acid in Tar-water will curdle Milk; yet Turpentine-water will not curdle Milk: which ſhows that Tar is conſiderably acidulated, by the Action of Fire in making. I find in a Pamphlet, intitled, *An Anſwer to a Letter to the Right Reverend the Biſhop of Cloyne, occaſioned by his Treatiſe on Tar-water*, that on diſtilling twenty-two Pounds of the beſt *Norway* Tar by two Retorts, there was

	Pounds.	*Ounces.*
Acid Spirit	1	2½
Oil	13	
Pitch	14	
	21	13½
Loft	0	2½
	22	

III.

BUT having procured four ſeveral Quantities of *Norway* or *Swediſh* Tar, which was not ſo ſtiff, but more ſoft and oily than the Tars mentioned in Numb. 3. and which were eſteemed by the Dealers in Tar to be very good for the common Purpoſes of Tar; I found much leſs Tar in the Tar-waters made with theſe, *viz.* only between five and fifteen Grains; and that, whether the Water were made by ſtirring four Minutes, or by dropping the ſame Tar five ſeveral times on the ſame Water, thro' the above-

mentioned Strainer; ſo that the Strainer was of little uſe, to leſſen the Quantities of Tar, in theſe kinds of Tar-waters; tho of uſe, the better to adjuſt the ſeveral Degrees of Strength deſired: And alſo of conſiderable uſe, in abating the Quantities of Tar, in the Tar-waters made both of the ſtiff Tars, and alſo of the coarſe *American* Tar, as appears by comparing the Events of each Manner of Preparation in Numb. 3, and 4. where it was found that the Tar-water made with the ſtiff Tar by ſtirring, had, in a Pint of it, forty four Grains of *Reſiduum*; and by dropping, eighteen Grains. The coarſe *American* ſtiff Tar had twenty-eight Grains by ſtirring, and but ſix by dropping. But it was obſervable, when the Tar dropped on the Water thro' the Strainer, that the Quantity of Oil which ſeparated from two of theſe thinner Tars, as it floated on the Surface of the Water, hindered the dropping Tar from ſinking into the

the Water: For which reaſon it was needful, from time to time, to put the ſwimming Oil and Tar gently by with a ſtick, and make it ſink. But the Oil of the other Tars did not prevent their ſinking down to the Bottom of the Water. Some of theſe Tars dropped very well through Holes, which were one eighth of an Inch in Diameter, without being forced through with the Plug.

9. 'Tis probable, that the greater Degree of Oilyneſs of theſe thinner Tars may prevent, in ſome meaſure, the groſſer Tar from incorporating with the Water in ſtirring. And perhaps, on the ſame account, they may likewiſe have ſomething leſs of what is called the acid Spirit: for the Water made with old, ſtiff, leſs unctuous Tar, and with ſtiff *Norway* Tar, ſeems to taſte ſenſibly ſtronger of the acid Spirit, than that made with thinner, more

more unctuous Tar; on which account the ſtiffer would be preferable, were it not, that it communicates too much of its groſſer Parts alſo to the Water; which yet is in a good meaſure prevented by the Strainer, as was found in Numb. 5. The Water made with the thinner Tar taſtes much ſtronger of Soot, than that made with the ſtiff Tars. Theſe ſtiffer Tars may probably be the latter Runnings of Tar in burning, for the laſt Runnings are ſo ſtiff as to be Pitch; ſo that the firſt Runnings, which come off with a ſmall Degree of Fire, may probably therefore approach nearer to the Nature of Turpentine than the latter.

10. Some of the more volatile Parts doubtleſs fly off in making Tar; for, as Dr. *Boerhaave* obſerves, the ſubtile, Æthereal Oil of Turpentine riſes with a Heat equal to leſs than half the Heat of boiling Water; which is ſo very penetrating

penetrating a Nature, that being anointed on the Surface of the Body, it will soon give a violet Smell to the Urine; but Drinkers of Tar-water inform me, that it does not give a violet, but tarrish Smell to the Urine.

IV.

WHEN we consider, that in burning Wood close covered up, either to make Charcoal or Tar, a considerable Quantity of the essential Salt is turned, by the Action of Fire, into fixed alkaline Salt; it seems not improbable, that a considerable part of whatever Virtue Tar-water has, may be owing not only to the subtile, volatile Acid of the Tar, but also to a fixed alkaline Salt, intimately united with the Oil of the Tar, and making thereby a penetrating, deterfive Soap. In the same manner as *Tachenius*'s Salt is made, by burning Rosemary in a covered Vessel, whereby the fixed Salt and Oil are intimately united, and

thereby

thereby become a mild, alkaline, saponaceous Substance, which, as Dr. *Boerhaave* observes, will mix well with the Humours of the Body. And may not even the subtile, volatile Salts, by the same means, be united with the subtile Oil, and thereby become a very penetrating, detersive, and attenuating volatile Soap?

V.

I Filtrated these several Tar-waters, thro' filtring Paper, yet no Tar, nor oily Substance, remained in the Paper; not even of that Tar-water, which had no less than ninety-three Grains of Tar in a Pint of it, Numb. 4. nor were the filtring Papers, when dry, any more inflammable, where the Tar had passed, than in other Parts, which had not touched the Tar-water. Nor was the filtring Paper of the thinner Tar at all discoloured, tho' that of the stiff was a little so. Hence we see how intimately and minutely

the Tar is mixed with the Water. No wonder then, since Water conveys so much Tar thro' the Filter, that it should also be a Vehicle to convey great Quantities of Tar into the Blood, as well as the Medicinal Virtue also into the finest and remotest Vessels of the Body, in the same manner that the Virtues of Mineral Waters are conveyed.

13. And as Tar is thus incorporated into the Water by stirring, so is the Water also thereby mixed with the Tar, so as to increase its Bulk very considerably. There is also a Water which separates from Tar, some time after it is made, and that in such Quantity, as to lay three or four Inches deep on the Tar. This Water, which is very strongly impregnated with the acid Spirit, is, as I am informed, drank by the *Americans*, as a Cure of some of their Maladies.

14. I observed that a Quart of Water, which had half a Pint of Tar ſtirred in it for four Minutes, was ſenſibly ſtronger than two Quarts of Water made with a Pint of Tar ſtirred as long a Time. And there is good Reaſon why it ſhould be ſo: for tho' a Pound of Sugar or Salt, by diſſolving throughly, will make a double Quantity of Water, juſt as ſweet or ſalt, as half a Pound will, half that Quantity of Water; yet as a large Quantity of ſo thick and unctuous a Subſtance as Tar is, cannot, by equal Times of Stirring, be ſo throughly ſtirred, as a leſſer Quantity can; ſo neither can its double Quantity of Water have ſo ſtrong a Tincture of the Tar, as the ſmaller Quantity of Water: but in the dropping way, the Strength will be in proportion to the repeated Numbers of Droppings.

95. As Tar by ſtirring becomes of a lighter brown Colour, ſo it will recover its darker Colour by ſtanding; and that ſoon, if warmed.

96. In theſe Evaporations of Tar-Water, Care muſt be taken to watch, when the Sediment begins to have a Syrup-like Thickneſs, and then to ceaſe the Evaporation, elſe no certain Eſtimate can be made of the Quantity of Tar; becauſe a great Part of it would be loſt by continuing the Heat.

VI.

97. As Tar and Turpentine are the Juices of the ſame Kinds of Trees, only procured in a different Manner, (the Turpentine being drawn off by Notches cut in the Fir-Trees while ſtanding; but Tar is procured by laying Fir-wood in great Heaps, and burning it while covered, with Sods or Turfs, which cauſes the Tar to run out at the Bot-

tom of the Oven, as it is called, in the same manner that Sap flows from Heaps of common Wood, while burning into Charcoal:) And as Tar-Water differs much from Tar taken in the gross, so may Turpentine-Water also differ from Turpentine: I thought it therefore not improper to repeat the same Experiments on Turpentine as on Tar.

18. But as there is a wide Difference between the mild, native, essential Salts of Vegetables, and the same Salts, which, when they have undergone the Torture of Fire, are become very caustick; so there may probably be a considerable Difference, in the Medicinal Virtues of Tar and Turpentine-Waters.

19. I made several Turpentine-Waters, both by stirring and dropping, with the same Proportion of Turpentine and Water, as of Tar and Water;

and

and found, that by ſtirring four Minutes, it had a too offenſive, bitterish, and peculiar Turpentine Taſte.

20. I ſtirred the ſame Half-Pint of Turpentine, in twelve different Quarts of Water; toward the latter Stirrings, the Turpentine grew leſs and leſs unctuous, ſo as to adhere but little to the Stirring-ſtick; nor was it diſpoſed to ſink in the Water ſo much as at firſt, being more ſpungy by much ſtirring; and it became almoſt as white as Paint of white Lead. The latter of the twelve Stirrings were gradually milder, and much leſs bitter, than the former; the Water was very little diſcoloured thereby.

21. The firſt and ſtrongeſt of theſe Waters paſſed through the filtring Paper, without leaving any viſible Turpentine; nor was that Part of the Paper, through which it paſſed, more inflammable when dry, than the other

Part;

Part; yet on evaporating away a Pint of this Water, there remained six Grains of gross Turpentine; and three Grains in a like Quantity of the twelfth Water.

22. When a like Quantity of Turpentine was dropped in very slender Threads, thrice on the same Water, thro' a Strainer, whose Holes were one sixth of an Inch in Diameter, it had a disagreeable Taste of Turpentine; and yet there remained but two Grains of Turpentine on the Evaporation of a Pint of it.

23. But on only once dropping of the Turpentine, it had a mild, balsamick Taste, which was not disagreeable: Tho' with *Venice* Turpentine, which is drawn from the Larch-Tree, it had a stronger, more disagreeable Taste. There was a thin Oil, which separated on the Surface of the Water, from the *Venice* Turpentine.

And

And as this Oil made the Turpentine float upon the Water, it was therefore requisite from Time to Time, gently to make them sink with a Stick, that the dropping Turpentine might touch the Water. But there was no thinner Oil separated from the common Turpentine in dropping on the Water, as there does from some Tars, whose more subtile Oil is separated from them by the Heat of Fire, in making the Tar.

VII.

24. AS these Tar and Turpentine-Waters were made with sweet Rain-water, in which there were Water-Gnats, (for the Waters still continue to produce innumerable flying Creatures, in conformity to the great Command, at the first Institution of Nature;) so it was very observable, that these Water-Gnats, and other small Insects, died, the first in six or eight Hours, the latter in thirty or forty Hours, in

Tar-

Tar-Water; yet neither of them were killed in the ſtrongeſt Turpentine-Water that I made; but continued brisk and lively for ſeveral Weeks: A probable Argument, that there is but little groſs Turpentine incorporated in the Water, for Turpentine kills Inſects.

25. Tho' the Degree of Fire which Tar undergoes in making, has made it thus deſtructive of the Lives of thoſe ſmall, tender Animals, yet we cannot thence infer, that Tar-Water is pernicious to Mankind, for the moſt cauſtick *American* Tar may be beſt in ſome Caſes; there being ſeveral powerful and ſafe Medicines, which have undergone the moſt intenſe Degrees of Fire, and are conſequently become thereby ſo much the more cauſtick, ſo as inſtantly to kill ſuch little Animals; an Inſtance of this, is Salt of Wormwood. Thus alſo all kinds of fermented, diſtilled, ſpirituous Liquors, which are rendered ſo cauſtick, by the

Heat of Fire which they undergo in Distillation, that they will instantly kill such Insects, yet have not the like Effect on Men: tho happy were it for Mankind if it were so; for that would effectually deter them from that destructive Peft, which, by its caustick burning Quality, however disguised with agreeable Flavours, and the plausible Name of Cordials, gradually destroys the Vitals, and thereby prematurely quenching the Lamp of Life, precipitates into their Graves vast Multitudes daily and yearly all over the World. How valuable a *Panacea* would Tar-water be, if it were as effectual a Remedy in preserving, as the other is in destroying Lives! Were it possible in the Nature of Things, that there could be such a Thing as a *Panacea*, in the vulgar Sense of the Word, it was never more wanted than in the present Age, to counter-act that great Bane of Mankind. But the present precarious and more uncertain State

of Health and Life, are better ſuited to our degenerate State, in order to reſtrain from farther Degeneracy, than ſuch a ſure Reſource for Recovery of Health would be. Yet how eagerly do Mankind catch at every Semblance of a *Panacea*, in hopes to prolong the preſent Life; tho' but too neglectful of that truly ſalutary Water of Life, which kind Providence tenders us, in order to extend Life thro' a happy Eternity!

VIII.

26. I MADE alſo the like Experiments with *Barbadoes* Tar; this being a *Petroleum*, or Mineral Tar, which iſſues out of the Earth, with Water from whoſe Surface it is ſcummed; and therefore a very different thing from the above-mentioned Tar of Fir-Trees. I ſtirred three Spoonfuls of it for four Minutes, both in a Quart of cold and hot Water. The Taſte of both theſe Waters was ſoft, mild, and

not disagreeable; that made with hot Water was something the stronger tasted. It will not curdle Milk, nor kill little Water-Insects. Being filtrated, it leaves no inflammable Matter in the filtring Paper, tho' the Paper is a little discoloured. On Evaporation of a Pint of the Water, the more subtile, volatile Parts flying away with the Heat, there remained five Grains, of a thin-spread, water-coloured transparent Substance, of a pungent, saline Taste, which would not ferment with Spirit of Nitre. I am informed that some in *Dublin*, have drank this instead of the other Tar-Water.

27. Dr. *Meighan*, in his Treatise of the Nature, and very powerful Efficacy of *Bareges* Waters, in the *Pyrenean* Mountains, both by bathing and drinking, finding that their Virtue consisted in a *Petrolæum*, with which they are richly impregnated, propoles, for the Benefit of those who cannot go

to *Bareges*, the impregnating Water with *Petroleum*, for the like Purpoſes, as a ſubſtitute Remedy, where we cannot imitate the Perfection of Nature's Preparation.

28. We have ſeen in the Courſe of theſe Experiments, the Quantity of Tar that there is in Tar-Water; and the great Difference of that Quantity, made with different Kinds of Tar, and different Degrees of Stirring. Now, ſince, notwithſtanding theſe Quantities of Tar, and the additional more ſubtile volatile Oil, which flies off in Evaporation, it has yet undoubtedly proved an efficacious Remedy in many Caſes and Inſtances; it may hence be reaſonably concluded, that the Medicinal Virtue of the Water does not reſide ſolely in the Acid, but partly alſo in the unctuous oily Parts, which are ſo temper'd by the Acid, as in ſome Caſes to prevent their heating too much. But whereas in ſome Caſes, it is obſerved

ſerved by Phyſicians, to be too inflammatory, it is probable, that heating Quality may in ſome Degree be abated, by making Tar-Water, with the Strainer above-mentioned, without Stirring; thereby to diveſt the Water of a good Quantity of its groſſer, tarriſh Particles, and yet retain whatever Powers it may have to do good. It is hoped, that the Light given by theſe Reſearches, may be of uſe in skilful Hands, for regulating and adapting the due Proportions of the acid, and the oily Principles, to different Caſes and Conſtitutions. This is the proper Province of the Phyſician, which I am no ways qualified to meddle in.

FINIS.

BOOKS written by Dr. *HALES*, and ſold by R. MANBY and H. S. Cox.

I. STatical Eſſays; containing Vegetable Staticks; or an Account of ſome Statical Experiments on the Sap in Vegetables: Being an Eſſay towards a Natural Hiſtory of Vegetation; of uſe to thoſe who are curious in the Culture and Improvement of Gardening, *&c.*

II. Statical Eſſays; containing Hæmaſtaticks; or an Account of ſome Hydraulick and Hydroſtatical Experiments made on the Blood and Blood-Veſſels of Animals.

III. Philoſophical Experiments; containing uſeful and neceſſary Inſtructions for ſuch as undertake long Voyages at Sea. Shewing how Sea-Water may be made freſh and wholeſome; and how freſh Water may be preſerved ſweet. How Biſcuit, Corn, *&c.* may be ſecured from the Weavel, Maggots, and other Inſects; and Fleſh preſerv'd in hot Climates, by ſalting Animals whole.

IV. A Deſcription of Ventilators; whereby great Quantities of freſh Air may with Eaſe be conveyed into Mines, Gaols, Hoſpitals, Workhouſes and Ships, in Exchange for their noxious Air. An Account alſo of their great Uſefulneſs in many other Reſpects: as in preſerving all Sorts of Grain dry, ſweet, and free from being deſtroy'd by Weavels, both in Granaries and Ships: and in preſerving many other Sorts of Goods, as alſo in drying Corn, Malt, Hops, Gunpowder, *&c.* and for many other uſeful Purpoſes.